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Settlement Confidential
Subject to FRE 408

August 17, 2012

VIA ELECTRONIC MAIL
AND FIRST CLASS MAIL

Allison Gardner, Esq.
Senior Assistant Regional Counsel
U.S. Environmental Protection Agency, Region III
1650 Arch Street (3RC42)
Philadelphia, PA 19103

Re: North Penn Area 5 Superfund Site, Colmar, Pennsylvania ("Site")

Dear Ms. Gardner:

In the time since our May 15, 2012 meeting, Honeywell International Inc. ("Honeywell") has been working to prepare a settlement approach hopefully to resolve this matter with the United States Environmental Protection Agency ("EPA"). At the outset, we wish to acknowledge the constructive discussion that we had during our May 15, 2012 meeting. In particular, we appreciate EPA's invitation to memorialize in writing the settlement analysis that we discussed at the meeting, and EPA's suggestion that we present a corresponding settlement offer. The following sets forth our analysis of: (1) EPA's de micromis and de minimis settlement policies; and (2) the bases for a reasonable settlement with EPA.

During our meeting, you also requested additional information regarding the groundwater modeling results that Honeywell presented, indicating historical pumping from wells NP-21 and NWWA-16 explains both the migration of TCE from BAE Systems source areas and the operable unit 2 ("OU2") plume footprint. In response to that request, please find attached: (1) a description of the modifications applied to the publicly available United States Geological Survey groundwater flow model for the Site to account for these historical pumping rates; and (2) the resulting model outputs. See Appendix A.

I. Background from the Administrative Record

EPA has alleged that Honeywell is a potentially responsible party (“PRP”) for the Site because it is “the corporate successor to another corporate entity (Baron Blakeslee, Inc. [“BBI”]) that arranged for the disposal of hazardous substances at the Site.”¹ In response to EPA’s recent Special Notice Letters (“SNLs”),² Honeywell undertook a thorough review of the administrative record to ascertain the basis and extent of BBI’s alleged nexus to the Site. Our review has indicated that BBI’s alleged nexus is substantially limited in at least three respects.

First, although the Site consists of three separate operable units, EPA has only alleged that Honeywell is liable for OU2. This is consistent with the administrative record, which contains no basis for contending that Honeywell is liable for either of the other operable units.

Second, the administrative record references one single leak associated with BBI’s activities on the Site. BBI sold trichloroethylene (“TCE”), which is a useful product, to Gas Springs Corporation (“Gas Springs”). Gas Springs then stored and used the TCE at its facility. On January 29, 1980, while BBI pumped TCE from a truck in the Gas Springs paved parking lot through hoses to a 1,000 gallon above ground storage tank located within the Gas Springs facility, a small leak occurred from the truck. Notably, the record contains no indication that BBI intentionally disposed TCE at the Site at any time or that any other TCE leaks at the Site are attributable to BBI (as required for arranger liability under *Burlington Northern*). Moreover, although the record indicates BBI owned the storage tank and removed spent TCE in drums from the Gas Springs facility, the record contains no evidence of any leaks from either the storage tank or any drum removal activities.

Third, the contemporaneous accounts of the January 1980 leak uniformly establish that the leak was miniscule—it consisted of drips that were mostly collected in buckets, with any uncollected drips landing on Gas Springs’ asphalt parking lot. Mr. Borchers, the North Penn Water Authority (“NPWA”) official who witnessed the leak, described the leak as dripping into buckets and noted that “[t]he majority of the leaking TCE did find its way into the buckets, however, small amounts did fall on the parking lot.”³ Indeed, Mr. Borchers appears to have believed that these small amounts of

¹ General Notice Letter from Henry J. Sokolowski, Chief, Superfund Enforcement & Federal Facilities Branch, EPA, to David Cote, President and Chief Executive Officer, Honeywell at 2 (May 12, 2004).

² On October 25, 2011, EPA sent Honeywell two SNLs. After several discussions with you, Honeywell responded to the SNLs by letter dated February 21, 2012. Subsequently, Honeywell requested, and you agreed to, a May 15, 2012 meeting between EPA and Honeywell to discuss Honeywell’s alleged nexus to the Site and a proposed path forward.

³ NPWA Spill Memorandum (Jan. 29, 1980) (emphases added), Appendix B.

uncollected TCE “probably evaporated on the parking lot before it reached the soil.”⁴ Mark Donohue, the BBI truck driver on that day, likewise described the leak as consisting of “a very minor drip” that “only occurred when the pump system was pressurized.”⁵

In sum, the administrative record reflects a limited alleged nexus that is based on a single leak, of which the “majority” was collected in buckets and only a small amount landed on Gas Springs’ asphalt parking lot.

II. Settlement Approach

A. Conservative Estimates Indicate Only a De Micromis Volume Leaked

In an effort to quantify the volume of the January 1980 leak, Honeywell retained Robert D. Mutch, Jr. to review the contemporaneous accounts of the leak and estimate, based on his experience with comparable TCE leaks, the volume of the January 1980 leak. Mr. Mutch’s attached memorandum details his methodology and results. *See* Appendix E. Utilizing conservative assumptions, Mr. Mutch estimates that the leak ranged in volume from 1.56 ml to 224 ml (0.05 oz to 7.57 oz), with worst case assumptions resulting in a volume between 112 ml to 224 ml (3.79 oz to 7.57 oz).⁶ For the reasons set forth in Mr. Mutch’s memorandum, this 112 ml to 224 ml (3.79 oz to 7.57 oz) range represents a conservative estimate of the amount of TCE that might have entered the subsurface. Even the high range of this conservative estimate is several orders of magnitude lower than CERCLA’s de micromis threshold of “110 gallons of liquid material.”⁷

It is far from clear, however, that any TCE from the January 1980 leak even entered the subsurface. The leak occurred on an asphalt parking lot that would have prevented TCE from entering the subsurface. Mr. Borchers’ opinion that the leaked TCE “probably evaporated on the parking lot before it reached the soil” supports this conclusion. Moreover, the Remedial Investigation sampling results did not reveal a TCE source area in the suspected vicinity of the January 1980 leak that would explain the OU2 TCE groundwater concentrations.⁸ These facts underscore the conservative nature of Mr.

⁴ Memorandum from P. J. Riley, to P. Dizikes, AR000060, Appendix C (emphasis added).

⁵ Report from Mark Donohue, BBI, (Jan. 29, 1980), AR000021, Appendix D; *see also* Letter from Edward E. Gillen, Vice President of Manufacturing, Gas Springs Corp., to Baron-Blakeslee (Feb. 5, 1980), Appendix E (noting that Gas Springs’ parking lot was asphalt).

⁶ *See* Memorandum from Robert D. Mutch Jr., P.Hg., P.E. at 4 (Aug. 3, 2012), Appendix F.

⁷ 42 U.S.C. § 9607(o)(1)(A).

⁸ Draft Remedial Investigation Report Revision 1, Remedial Investigation and Feasibility Study Volume 1 of 3 (July 2002) at AR200919-AR200920.

Mutch's estimate and challenge the view that any TCE from the January 1980 leak entered the subsurface.

During our May 15, 2012 meeting, it was suggested that Mr. Borchers' report of the leak could be construed to suggest that the leak was larger than Mr. Mutch's estimates. As discussed in the meeting, the facts in the administrative record do not support such conjecture. First, the suggestion that the leak could be observed from a distance, and therefore must have been large, is not supported by Mr. Borchers' firsthand account. Mr. Borchers does not state that he, or anyone else, noticed the leak from a distance. Rather, he provides that "while investigating trichloroethylene contamination on the property of American Electronics Labs., Inc. [("AEL")]" he and a colleague "noted a tank truck being unloaded on the Gas Spring property." Mr. Borchers notes that the truck was leaking only after he states that he "entered Gas Spring's parking lot and inspected the truck unloading," suggesting it was not until he approached the truck in the parking lot that he observed the leak. Second, regardless of the significance one might attribute to his description of TCE "running across the running board" of the truck, Mr. Borchers' description of the leak itself indicates it was a small volume. Mr. Borchers described the leak as "dripping," noted that a "majority" of the "dripping" "did find its way into the buckets," and described the uncollected volume as "small amounts." Collectively, these descriptions indicate that the TCE volume that reached the Gas Springs parking lot was small. Attempts to infer a greater volume based on BBI's reported use of two buckets to collect the leak are inconsistent with these explicit descriptions. Finally, Mr. Borchers' conjecture that leaked TCE "would find its way into a storm drain at the base of the unloading area" does not indicate that TCE from the January 1980 leak in fact flowed to the storm drain. Mr. Borchers did not, for example, describe a TCE flow path or state that he observed TCE flowing to the storm drain. These conspicuous omissions indicate that Mr. Borchers did not observe TCE flowing to the storm drain on January 29, 1980, but was merely speculating as to the possible sources of the TCE contamination he was investigating on the AEL property. Indeed, upon further reflection, Mr. Borchers appears to have believed that the leaked TCE "probably evaporated on the parking lot before it reached the soil."

In conclusion, the single TCE leak attributed to BBI in the administrative record was several orders of magnitude below CERCLA's de micromis volume threshold of 110 gallons.

B. De Micromis Statutory Exemption and EPA Settlement Policy

CERCLA Section 107(o) provides a statutory exemption from CERCLA liability for PRPs whose liability "is based solely on" CERCLA Section 107(a)(3) or (4) (i.e., arranger or transporter liability) where:

- 1) "The total amount of material containing hazardous substances contributed by the part to a Site was less than 110 gallons of liquid materials or less than 200 pounds of solid materials;

- 2) The site is listed on the NPL; and
- 3) All or part of the party's disposal, treatment or transport occurred before April 1, 2001."⁹

In addition, EPA guidance encourages settlement with "non-exempt de micromis parties," who "fall outside the statutory [de micromis] definition," but "their waste volume is extremely small compared to the traditional *de minimis* party's volume addressed by [CERCLA] Section 122(g)."¹⁰ "EPA believes such non-exempt de micromis parties should not be pursued or otherwise compelled to expend transaction costs to resolve potential CERCLA liability."¹¹ "For these parties, the administrative costs of determining and verifying the party's share, if any, and the cost of collecting the small payment, usually far exceeds that share."¹² EPA "considers settlements with non-exempt de micromis parties to be a subset of *de minimis* settlements under CERCLA Section 122(g),"¹³ which by statute EPA must extend to eligible PRPs "as soon as possible" after receiving sufficient information to render an eligibility determination.¹⁴

Honeywell satisfies each of the four requirements for a CERCLA Section 107(o) statutory de micromis liability exemption.¹⁵ First, EPA has alleged that BBI's liability for the Site is premised on arranger liability.¹⁶ Second, as the administrative record documents and Mr. Mutch estimates, the volume of the sole TCE leak attributed to BBI in the administrative record was several orders of magnitude "less than 110 gallons."¹⁷ Third, the Site is listed on the NPL.¹⁸ Fourth, "all or part of the disposal, treatment, or

⁹ EPA, Revised Settlement Policy and Contribution Waiver Language Regarding Exempt De Micromis and Non-Exempt De Micromis Parties at 4 (Nov. 6, 2002) (hereinafter, "De Micromis Policy"); *see also* 42 U.S.C. § 9607(o).

¹⁰ De Micromis Policy at 4.

¹¹ *Id.* at 2.

¹² *Id.*

¹³ *Id.* at 4.

¹⁴ 42 U.S.C. § 9622(g)(3); *see also id.* § 9622(g)(10); EPA, Interim Guidance on the Ability to Pay and *De Minimis* Revisions to CERCLA § 122(g) by the Small Business Liability Relief and Brownsfield Revitalization Act at 7 (May 17, 2004).

¹⁵ 42 U.S.C. § 9607(o).

¹⁶ *E.g.*, General Notice Letter from Henry J. Sokolowski, Chief, Superfund Enforcement & Federal Facilities Branch, EPA, to David Cote, President and Chief Executive Officer, Honeywell at 2 (May 12, 2004) (alleging that Honeywell is "the corporate successor to another corporate entity (Baron Blakeslee, Inc.) that arranged for the disposal of hazardous substances at the Site").

¹⁷ 42 U.S.C. § 9607(o)(1)(A).

¹⁸ National Priorities List for Uncontrolled Hazardous Waste Sites - Final Update No. 5, 54 Fed. Reg. 13296 (Mar. 31, 1989).

transport concerned occurred before April 1, 2001,”¹⁹ because the sole leak attributed to BBI occurred on January 29, 1980. Accordingly, Honeywell is entitled to the statutory *de minimis* exemption and EPA should no longer consider Honeywell to be a PRP in this matter.

Even assuming, *arguendo*, Honeywell did not satisfy one of the aforementioned statutory requirements (which it does), the facts in the administrative record would still support extending Honeywell a “non-exempt *de minimis* party” settlement at this time. The volume of the sole TCE leak attributed to BBI in the administrative record was several orders of magnitude less than the 110 gallon *de minimis* threshold. Additionally, Honeywell’s good faith participation at this Site to date compels the same result. For approximately ten years, Honeywell has cooperated with EPA at the Site, including reviewing and providing comments on numerous documents (e.g., the RI/FS and bioremediation proposed remedial action plan) and has expended approximately \$360,000 in technical costs (i.e., excluding substantial internal and legal costs).

Based on the estimated volume of the sole BBI leak, Honeywell’s level of participation and \$360,000 in financial expenditures “far exceeds [its] share” of the OU2 costs and Honeywell “should not be pursued or otherwise compelled to expend transaction costs to resolve potential CERCLA liability.”²⁰ As detailed in Mr. Mutch’s attached memorandum, conservative estimates of both the volume of the TCE leak attributable to BBI and the mass of TCE in the OU2 plume indicate that BBI’s leak could at most constitute approximately 0.0110% to 0.0218% of the mass of the OU2 plume.²¹ In addition, based on a review of comparable sites, a reasonable estimate of the potential range of OU2 remedy costs would likely be \$16 million to \$34 million.²² Consistent with EPA guidance,²³ applying these remedy costs to the conservative estimates of the percentages of TCE in the OU2 plume possibly attributable to BBI results in a share of OU2 costs in the range of approximately \$1,760 to \$7,420, at most. Honeywell’s expenditure of \$360,000 to date “far exceeds” this range. Consequently, EPA Guidance dictates that Honeywell “should not be pursued or otherwise compelled to expend transaction costs to resolve potential CERCLA liability” in this matter and is entitled to a “non-exempt *de minimis* party” settlement.²⁴ Given Honeywell’s substantial level of

¹⁹ 42 U.S.C. § 9607(o)(1)(B).

²⁰ De *Micromis* Policy at 2.

²¹ See Memorandum from Robert D. Mutch Jr., P.Hg., P.E. at 12 (Aug. 3, 2012), Appendix F.

²² See Memorandum from Gary DiPippo, Cornerstone Environmental Group at 3, Appendix G.

²³ See EPA, Streamlined Approach for Settlements with De Minimis Waste Contributors under CERCLA Section 122(g)(1)(A) at 3-4 (July 30, 1993) (explaining how to calculate a *de minimis* settlement payment).

²⁴ De *Micromis* Policy at 2.

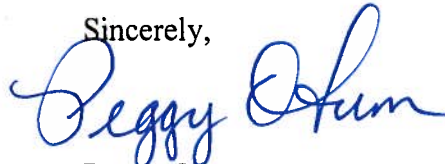
Allison Gardner
U.S. Environmental Protection Agency
August 17, 2012
Page 7

participation and final expenditures to date, no further consideration from Honeywell is appropriate or necessary for such a settlement.

* * *

For the reasons set forth herein and in the attached technical memoranda, settlement of this matter on the basis of Honeywell's status as a de micromis party is appropriate. Given Honeywell's significant expenditures for OU2, this matter should be resolved promptly with no further participation or consideration from Honeywell. We note that Honeywell recently received a courtesy copy of the Unilateral Administrative Order ("UAO") that EPA issued for OU2 (supplemental RI/FS and interim bioaugmentation remedy). We view EPA's decision not to include Honeywell as a responding party to the UAO to be consistent with both the administrative record and ultimately a decision by the Agency that Honeywell should not be pursued any further. Honeywell looks forward to receiving correspondence from you confirming that EPA no longer considers Honeywell a PRP for the Site. If you have any questions about this, please do not hesitate to call me at (202) 942-5965.

Sincerely,



Peggy Otum

Enclosures

cc: Tom Byrne, Esq. (Honeywell)
Chris French (Honeywell)
John Morris (Honeywell)
Eric Rey, Esq.

Appendix A



To: Chris French
Date: August 1, 2012
Page: 1

Memorandum

Date: August 1, 2012
From: Alex Spiliotopoulos, Senior Project Hydrogeologist
Steven P. Larson, Executive Vice President
To: Chris French, Remediation Manager, Honeywell
Project: Stabilus - North Penn Area 5, PA
Subject: **Contaminant migration pathway evaluation at the Stabilus Site – Scenario 1**

The groundwater flow model developed by the USGS (Dennis W. Risser and Philip H. Bird, USGS-WRIR 03-4159, 2003) was used to evaluate contaminant migration pathways at the Stabilus site. The groundwater flow model was considered reliable for the purposes of analysis of contaminant migration in a highly heterogeneous aquifer.

The groundwater flow model is a multi-dimensional, finite-difference model encompassing approximately 12 mi². It consists of 80 rows, 123 columns (with cell sizes varying from 66x66 ft² to 328x328 ft²), and 8 layers. Layers 1, 2, and 8 are horizontal layers and layers 3, 4, 5, 6 and 7 are dipping layers. Layer 1 represents the weathered part of the aquifer, layers 2 and 8 the regional extent of the aquifer, and layers 3 through 7 represent dipping geologic units that strike 35° to 70° NE, and dip 10° to 30° NW. The mean strike is N^o.62 E., and the dip is 31° NW. Layers 4 and 6 are the two major water-yielding zones, where the municipal pumping wells are screened. The model was calibrated to average, non-pumping, steady-state conditions and May 2002 pumping tests results (well NP-87). No historical pumping data were considered.

Contaminant migration evaluation was performed for various pumping scenarios. The goal of a number of those scenarios considered in the analysis was to determine the effects of historical pumping from wells NP-21 and NWWA-16. For that reason the model was modified by SSP&A to consider:

- (a) The historical operation of well NP-21. North Penn Water Authority well NP-21 preceded NP-87, and according to NPWA was a significant water supply resource. Historical pumping data for NP-21 were obtained from the Delaware River Basin Commission (DRBC) for the period 1987-1998 (the only data available).
- (b) The historical operation of public supply well NWWA-16, from which large water withdrawals were made by the North Wales Water Authority. Based on the well coordinates and screen elevation data, the well was assigned to Row 45, Column 91 and Layers 4 and 6 in the groundwater model grid. Available data were obtained from DRBC for the period 1987-1996.



S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

To: Chris French
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Based on the monthly production records for NP-21 for the ten-year period 1987 to 1996, the maximum monthly pumping rate from well NP-21 was only 206 gpm. The maximum monthly use of this well occurred in November 1992. Pumping rates in other months during the ten-year period were typically much less than 200 gpm. The maximum annual pumping rate during the ten-year period was only 144 gpm, which also occurred in 1992. Average annual pumping rates were reported to be as high as 190 gpm in the early 1980's. These data together indicate that the actual yield of NP-21, as part of the North Penn water system, is less than 200 gpm.

Well NWWA-16 pumping rates for the period 1987-1996 varied between 80 and 310 gpm, with an average value of around 200 gpm. Higher pumping rates were observed in late 80's and early 90's.

For the modeling outputs presented in the attached Appendix, well NP-21 was considered to be pumping at a rate of 160 gpm. It was assumed that the pumping rate of NWWA-16 varied around its average value during the 1980s. Consequently, two modeling outputs are shown for USGS model Layer 1 (Saprolite) for NWWA 16. The first output (Figure 1) depicts advective transport (illustrated by particle traces) for particles originating in Layer 1 under an average pumping rate of 150 gpm. The second output (Figure 2) depicts advective transport for particles originating in Layer 1 under an average pumping rate 200 gpm. Particle tracking was performed based on the same parameters used in the USGS model.



S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

To: Chris French
Date: August 1, 2012
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APPENDIX:
Groundwater Modeling Results

To: Chris French
Date: August 1, 2012
Page: 4

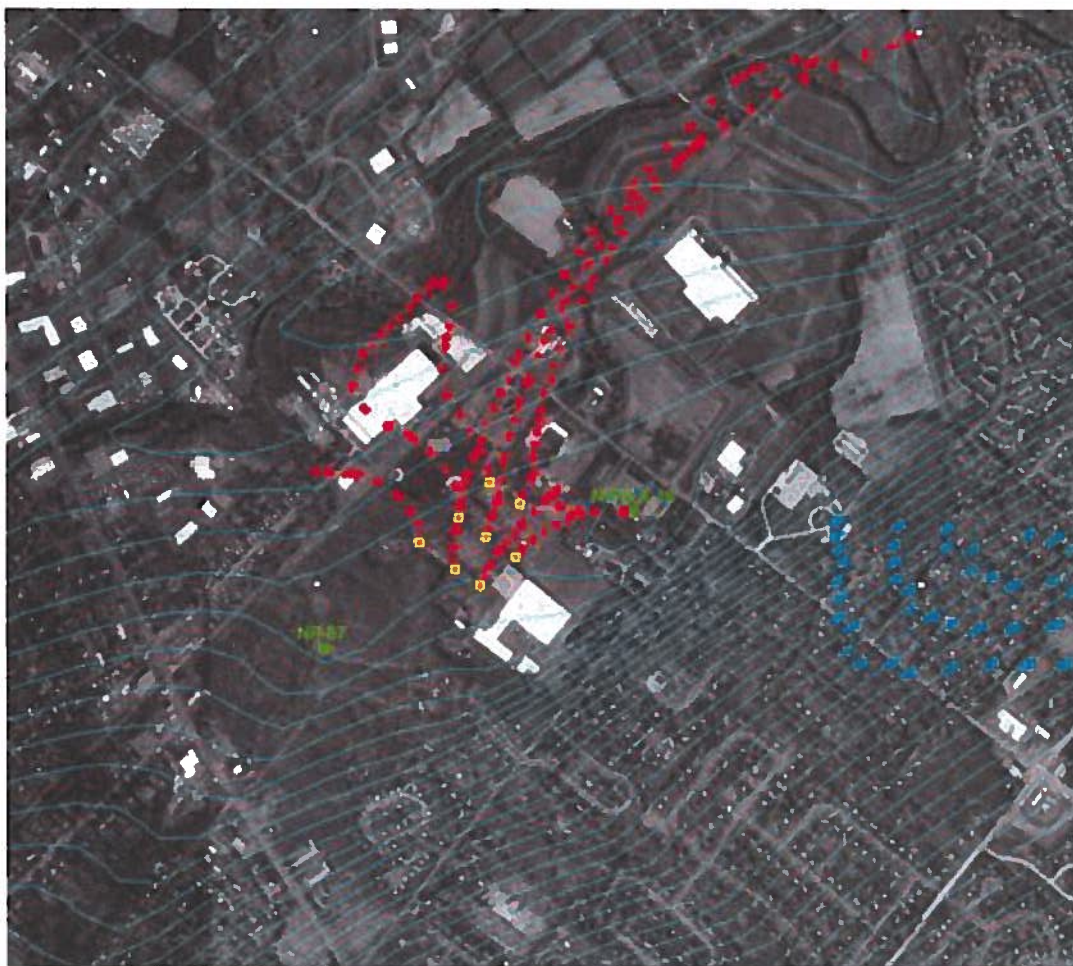


Figure 1: Scenario 1 – Particle Traces in Layer 1 when NWWA-16 operating at 150 gpm.

To: Chris French
Date: August 1, 2012
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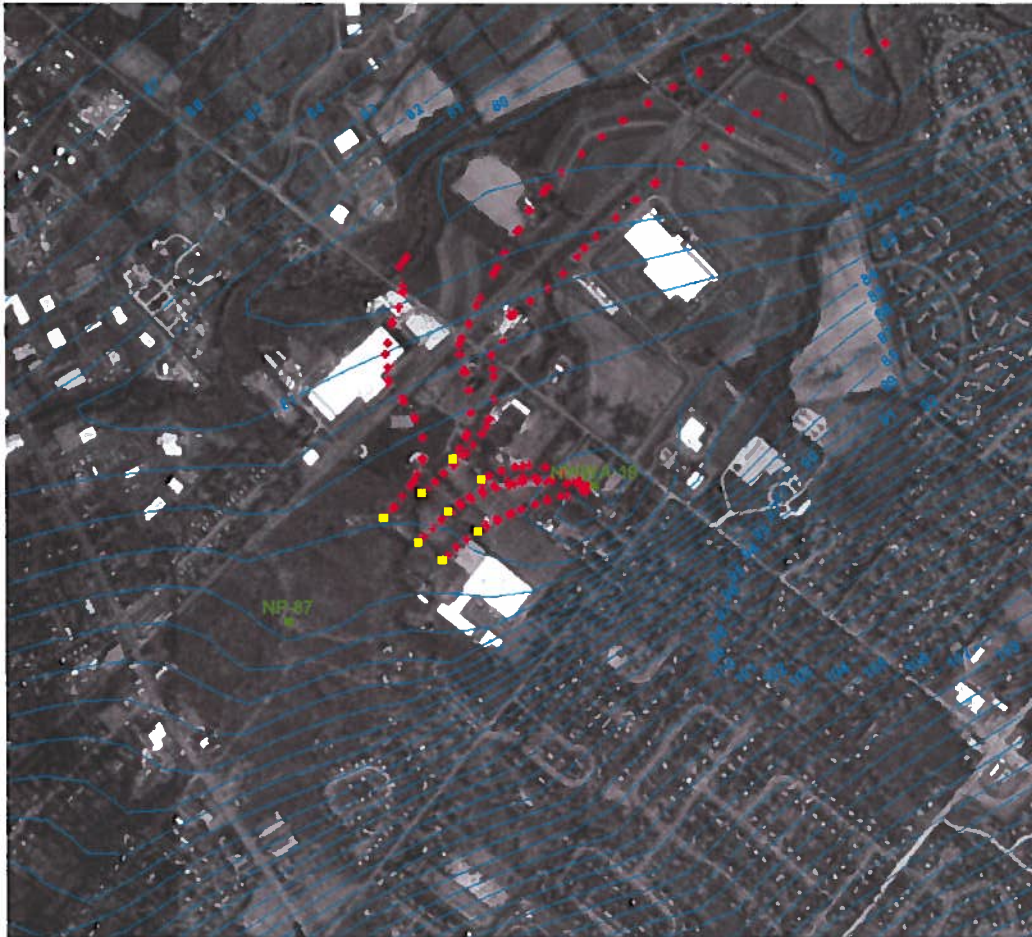


Figure 2: Scenario 1 – Particle Traces in Layer 1 when NWWA-16 operating at 200 gpm.

Appendix B



FAX TRANSMISSION

To: Brian Israel, Esq.
Arnold & Porter LLP

Date: December 1, 2004

Fax #: 202-942-5999

Pages: 2, including this cover sheet.

From: Allison Gardner
Assistant Regional Counsel
US EPA, Region III
215-814-2631

Subject: North Penn Area 5 Superfund Site

COMMENTS:

Brian,

I have attached the document you requested during our telephone conversation on November 29. Please let me know if you have any questions.

Regards,

Allison F. Gardner

GAS SPRING CORP.
COUNTY LINE ROAD

1-79-80

On the above date, H. Borchers, NPWA and Robert Buller, BCM, while investigating trichloroethylene contamination on the property of American Electronics Labs., Inc., noted a tank truck being unloaded on the Gas Spring property. We entered Gas Spring's parking lot and inspected the truck unloading. We noted what appeared to be TCE leaking from flanges on the truck's pumping equipment. TCE was running across the running board and dripping into two 5-gallon buckets which had been placed by the driver to collect the spillage. The majority of the leaking TCE did find its way into the buckets, however, small amounts did fall on the parking lot. When the driver returned to the truck, we informed him of our problems with TCE and suggested he get his truck repaired as quickly as possible. He said the truck was due to go into the shop the next day. The truck was owned by a Baron-Blaksee of New Jersey (telephone - 609-833-0355). Any quantity of TCE leaking from a vehicle at the location would find its way into a storm drain at the base of the unloading area. This drain is piped to a creek and retention area between Leeds and Northrup and Gas Spring plants. We should probably take soil samples in this area to see if TCE pollution has occurred in this swampy area.

When I returned to the office I received a call from Mrs. Guest of Baron-Blaksee Company of New Jersey. She informed me they definitely would have the vehicle fixed the next day and apologized for the incident. This incident was also reported to Ed Laquer, a consultant who previously contacted me concerning Gas Spring.

On February 3, Mr. Ed Gillen of Gas Spring Corp. called me on the phone and advised me that he would send a letter to Baron-Blaksee requesting they assure Gas Spring their equipment has been maintained. In the meantime Gas Spring will not allow anyone to deliver TCE to their plant without their own employees checking the installation. They will put a lock cap on the trichloroel tank so it cannot be filled without the company's being aware. Mr. Gillen said Gas Spring has been in contact with AEL concerning the TCE groundwater contamination. I mentioned to Mr. Gillen we had found trichloroel pollution in their sanitary sewer line at an earlier date and our test drilling on AEL property indicates a degree of contamination in the vicinity of Gas Spring property. I did not divulge the figures or exact results as I felt this was confidential between AEL and NPWA.

GAS SPRING CO

GRAB BAG

Copy for NPWA

Appendix C

memorandum

P. Dizikes

MAILSTOP FROM

1260

P. J. Riley

SUBJECT

Meeting with Harry Borchers, Ground Water
Recovery Plan

On Tuesday, December 2, I met with Terry McManus, Jon Carter, and Harry Borchers, N.P.W.A. The primary reason for the meeting was to review for Harry the progress on the Ground Water Recovery Plan. Terry gave a thorough exposition of that which has been done to date and the program for the immediate future.

The discussion reached a point which prompted me to ask Harry if he was thoroughly convinced that AEL was the sole contributor to the contamination of NP-21. After noticeable hesitation, he responded by saying that AEL was certainly the significant source of contamination, an answer which evaded the question. I then asked him what was he doing to locate other possible contributors. He said that his attorneys and the EPA lawyers -- without naming the latter -- have told him that he "has AEL on the hook, that he doesn't have to look anywhere else and he should look to AEL for correction". Further, said Harry, they told him that it would be up to AEL to determine who else might be contributing to the well's contamination, that AEL would have to identify these contributors and prove the extent of their contamination.

I stated to Harry that AEL had gone to considerable effort and expense in cleaning up the evident contamination and that the company would certainly continue its program to correct the conditions. I pointed out to him, however, that cleaning-up the situation might not necessarily clean up NP-21, that we were determined to be in compliance with DER with respect to eliminating any objectionable condition created by AEL but that I did not agree that AEL was thereby undertaking making NP-21 TCE-free because there are too many other possibilities for the well's contamination.

I reminded Harry that he and Bob Buller had personally seen a truck pumping TCE into Gas Spring, that the hose lines were leaking TCE into a bucket and that the TCE was running along the macadam. In view of this, I asked, had he considered the possible role of Gas Spring in the NP-21 contamination. Harry gave a very off-hand dismissal of the subject saying the TCE probably evaporated on the parking lot before it reached the soil; in general he didn't appear too interested or concerned about what he had noted. Then Harry said if AEL knew of any conditions at Gas Spring we should bring it out into the open. Jon Carter said that we had heard some rumors but that was the extent of our knowledge of what goes on at Gas Spring. My comment to Harry was that if he had come to AEL and had seen the same condition, with TCE running along the macadam, he would have come down on AEL with both feet and I failed to understand why he hadn't done so at Gas Spring.

Harry was insistent that AEL take a course of action which differed from that which had been approved and encouraged by DER. The final impression I had is that Harry was not pleased or particularly satisfied with AEL's direction.

cc: S. B. Disson, J. Carter

PJR/pas

FOR MULTIPLE ADDRESSES SIMPLY CHECK NAME, FOLD AND STAPLE. NO ENVELOPE NEEDED

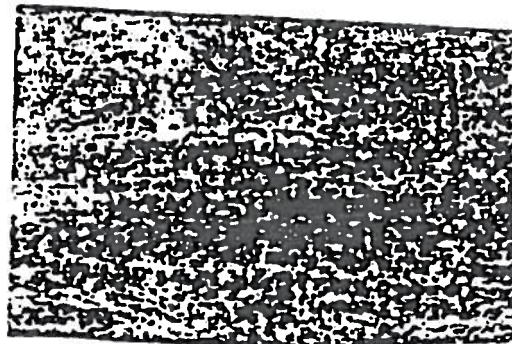
Appendix D

Tuesday, January 29, 1980

After making a pump delivery to Gas Spring Corp. in Colmar, Pa. I moved the truck from the garage door, where I run the hose into the 1000 gal. tank, to the loading dock to pick up sludge from customer.

When I stepped out of the truck, a man in a blue Ford station wagon pulled up along side the truck and came over to me. He said "do you know you're leaking?" I replied, "I'm not leaking now!" He then said, "do you mind telling me what you are (delivering or carrying)." I then asked if he would mind showing me some I.D. He replied, "not at all" and gave me his business card. He then asked me if I was carrying Trichlorethylene and I said yes I was carrying Tri. We then walked around to the cabinet for the hose reel and I showed him the truck was no longer leaking, and I explained that the leak, a very minor drip, only occurred when the pump system was pressurized and I put buckets under the leak. He said he was out by the truck while I was inside making my delivery and had seen the buckets and the leak. I then told him the leak had just recently started (since the extreme cold weather, about 4-5 days) and had already been reported to the front office and scheduled to be repaired. He asked what we did with the drippings from leaks in the bucket. I told him we had sludge drums at the warehouse and I emptied the buckets into sludge drums after returning to the warehouse. He then said "we have been doing water testing in the area and had found TCE in the water at 4 or 40 (?) parts per million or billion (?) and I realize this type of leak could not be the sole source of the problem, but leaky equipment must fit into the picture somewhere!" He then took name and phone number of company and departed in his car.

Mark Denslow



Appendix E

cc Doc. 75-2nd
file (7)



**GAS SPRING
CORPORATION**

MAIN OFFICE AND PLANT
92 County Line Road
Colmar, PA 18915
Phone (215) 822-1982
TWX 510/661-6732
5 February 1980

Baron-Blakeslee
1531 Grandview Avenue
Thorofare, New Jersey 08086

Re: TCE

Gentlemen:

On 29 January 1980, Mr. Harry Borchers, Executive Manager, North Penn Water Authority, witnessed the pumping of TCE from your truck into our 1,000 gallon inside storage tank.

He commented to your driver about the dripping of TCE from your truck to the ground. Although your driver did use some buckets to collect the dripping TCE before it fell onto the asphalt, Mr. Borchers said that some ground spilling did occur.

In a conversation with Mr. Borchers today, he said your Mrs. Getz called him about the cause of the dripping and that it would be corrected.

Since we both must insure that TCE is properly dispensed and used, we will put a lock on our intake line and be with your driver during delivery to prevent any possible leakage to the ground.

Jim Oplinger, our Plant Engineering Manager or myself can be contacted to set up and establish any other controls which you may suggest to insure leak free delivery.

Sincerely,

GAS SPRING CORPORATION

Edward H. Gillen
Vice President/Manufacturing

EHG:jss

Appendix F



Settlement Confidential
Memorandum

Project Number: HWEL.019

To: Chris French, Remediation Manager, Honeywell
From: Robert D. Mutch Jr., P.Hg., P.E.
Subject: Estimate of the Fraction of TCE in the OU2 Plume Attributable to TCE Potentially Entering the Subsurface as a Result of the January 29, 1980 Event at the Gas Spring Corporation (Stabilus) Site
Date: August 3, 2012

At the request of counsel, we have prepared this memorandum summarizing our estimation of the fraction of TCE in the OU2 plume attributable to TCE that potentially could have entered the subsurface as a result of the observed dripping of TCE during the delivery of TCE to the Gas Spring Corporation facility on January 29, 1980. This assessment requires that two calculations be undertaken. First, the amount of TCE that could have entered the subsurface as a consequence of the January 29, 1980 incident must be estimated. This calculation becomes the numerator of the fraction. Second, the total amount of TCE mass in the OU2 plume must be determined, which serves as the denominator of the fraction of mass attributable to the January 29, 1980 incident. We begin with a calculation of the amount of TCE that could have been released to the subsurface as a consequence of the January 29, 1980 incident.

1 Calculation of the Amount of TCE that Could Have Been Released to the Subsurface as a Consequence of the January 29, 1980 Incident

We begin with the dual descriptions of the occurrence of the release and some additional background information.

1.1 Background

On January 29, 1980, Mr. Harry Borchers, Executive Manager of the North Penn Water Authority (NPWA), noticed leakage being collected in buckets by a Baron Blakeslee (BBI) delivery truck. He describes the incident as follows in a memorandum dated January 29, 1980:

“We noted what appeared to be TCE leaking from [the truck’s] equipment. TCE was ... dripping into two 5-gallon buckets which had been placed by the driver to collect the spillage. The majority of the leaking TCE did find its way into the buckets; however, small amounts did fall on the parking lot.”

Mark Donohue’s (the BBI driver) account is not substantially different. The most pertinent section of his account describing the driver’s interactions with Mr. Borchers is as follows (Memo from Mark Donohue, dated January 29, 1980):

“I showed him the truck was no longer leaking, and I explained that the leak, a very minor drip, only occurred when the pump system was pressurized and I put buckets under the leak.”

A letter from Gas Springs Corporation's Vice President, Mr. Edward Gillen to Baron Blakeslee, dated February 5, 1980 also described the incident as reported to them by Mr. Borchers of the NPWA:

"He commented to your driver about the dripping of TCE from your truck to the ground. Although your driver did use some buckets to collect the dripping TCE before it fell onto the asphalt [sic], Mr. Borchers said that some ground spilling did occur."

One can draw from these similar accounts several important factors that bear on the extent of TCE that potentially reached the subsurface as a consequence of this incident.

1. Both accounts describe the leak as "dripping" or as "a very minor drip".
2. Both accounts agree that buckets were used to capture some of the dripping, Mr. Borchers adding the acknowledgement that "the majority" of the dripping was captured by the buckets.
3. Both accounts indicate that to the extent that drips did contact the ground it was on the asphalt pavement of the parking lot.
4. The driver's account also indicates that the dripping only occurred when the "pump system was pressurized" during filling of the tank.

Investigations of the suspected area of the spill during the RI did not reveal soil contamination indicative of a significant source (TetraTech, 2002). In connection with their direct push and confirmatory membrane interface probe investigation of the suspected area of the spill, TetraTech concluded the following:

"These sample results do not seem to be indicative of a source area that could result in groundwater concentrations as high as that detected in the direct push samples or the on-site monitoring wells. Therefore, these sample locations probably do not represent the major TCE source area at the Stabilus facility. "

1.2 Calculations

These similar descriptions of the incident allow one to estimate the amount of TCE that may have reached the subsurface. In so doing, four factors must be considered:

- a) The duration of the delivery, specifically the time period during which the pumping system was pressurized, since dripping is reported to only have occurred during this period of pressurization.
- b) The drip rate during the delivery period (i.e. number of drops per second)
- c) The size of a drop of TCE
- d) The fraction of the dripping that was not subject to either evaporation or capture in the buckets and therefore could have reached the subsurface.

We will look at each of these factors individually.

1.2.1 Duration of Delivery

The duration of the delivery can be estimated by considering how much TCE was delivered and the average pumping rate. Gas Spring Corporation had a 1000 gallon tank inside the building (owned by BBI) that it used for TCE storage (TetraTech, 2002). Based upon delivery records, 621.4 gallons of TCE

were delivered on January 29, 1980.¹ Tank trucks of the type used to deliver TCE typically have pumping rates that range from 40 to 100 gallons per minute with 60 gallons per minute being fairly typical (Cherokee Enterprises, Inc. 2010; personal communication Oilmen's, May 2012). For the purposes of this calculation, I will assume that the flow rate could have varied from 30 to 60 gallons per minute. That range of pumping rates translates to a fill time of approximately 10.4 to 20.7 minutes, respectively.

1.2.2 Drip Rate

The rate of dripping was not measured in the above accounts of the incident. I will, therefore, use a range of drip frequencies from one drop every two seconds to four drops per second (beyond four drops per second, leakage becomes more of a steady stream).

1.2.3 Drop Size

A drop of *water* (not TCE) has a volume of about 0.05 ml (Schreiner O., 1901). The size of a drop of fluid is a function of the fluid's surface tension and density. Fluids with higher surface tension tend to form larger droplets and vice versa. Density is inversely correlated with drop size. TCE has both a significantly lower surface tension and a higher density than water and would therefore be expected to have a significantly smaller drop size than water. As an example, Harrold, et al, (2001) measured the size of a TCE drop as 0.015 ml, which is less than one third the size of a typical drop of water. For the sake of conservatism, I have assumed that a drop of TCE is equivalent in size to a drop of water, or 0.05 ml.

1.2.4 Fraction of Dripping Not Subject to Evaporation or Capture

As described above, it has been reported by both observers of the incident, that much of the dripping of TCE was captured by buckets. The portion not captured by buckets would have dropped onto the asphalt pavement² of the parking lot. At that point, it would be subject to either evaporation or potential percolation through the asphalt either through any primary pore spaces or cracks in the asphalt pavement. It is entirely conceivable that the asphalt pavement could have been sufficiently intact and non-porous that none of the TCE would have percolated through it into the subsurface. However, for the sake of conservatism, I will assume that some portion of the TCE that dripped onto the asphalt pavement would not have been subject to evaporation and might therefore have percolated through the asphalt. In a subsequent calculation, I use a range of the total fraction subject to evaporation or capture ranging from 0.1 to 0.9.

¹ The earlier version of this estimate presented to EPA during a May 15, 2012 meeting assumed that 900 gallons of TCE were delivered on January 29, 1980. This assumption was necessary because information regarding the delivery volume were unavailable at that time. Subsequent to the meeting, EPA's electronic administrative record for the Site was supplemented to include a document indicating that 621.4 gallons were delivered on January 29, 1980. Bulk Delivery of Trichloroethylene (Blaco-Tri), AR000063. Accordingly, this estimate has been revised to reflect this new information regarding the amount of TCE delivered on January 29, 1980.

² Asphalt pavement consists of a mixture of stone aggregate and an asphalt binder. The permeability of asphalt pavement to water is a function of the extent that the aggregate pore spaces are filled with asphalt binder. Asphalt pavement can also have what is commonly termed "secondary" permeability if it has cracks or joints due to settlement or aging. It is unlikely that cracking and jointing was a significant factor in this case since the Gas Springs Corporation plant was constructed in 1979—only the year before the incident (USEPA, 2012)

Employing all of the above-described factors, it is possible to calculate a range of TCE potentially released to the subsurface from the January 29, 1980 event. The range of potential amounts of TCE released is presented in Table 1. Table 1 shows two tables, each representing a matrix of potential amounts of TCE released to the subsurface in milliliters. The upper table represents a shorter delivery period of 10.4 minutes, which is associated with an average pumping rate of 60 gallons per minute. The lower table represents a longer delivery period of 20.7 minutes, which is associated with an average pumping rate of 30 gallons per minute. The first column of each table in red gives the drip frequency in drops per second ranging from 0.5 to 4 drops per second. At the top of each subsequent column in the table (shown in blue) is the fraction of the dripping subject to evaporation and capture. These values range from 0.10 to 0.90 in the five columns. The calculated values in the white central portion of each table represent the estimated release of TCE to the subsurface in milliliters associated with the drip rate and the fraction subject to evaporation and capture. A large fraction of the calculated values are in the range of a few tens of milliliters of TCE released. Even under worst case assumptions, the release to the subsurface under a 10.4 to 20.7 minute delivery period ranges from only 112 to 224 milliliters (0.112 to 0.224 liters). Given the density of TCE of 1.47 g/ml (Cohen and Mercer, 1993), the calculated volume of TCE translates to a mass of between 0.165 to 0.329 kilograms (0.364 to 0.725 pounds).

Table 1
Estimated Amount of TCE Release in Milliliters
Associated with January 29, 1980 Event

Duration of Delivery = 10.4 minutes (Q = 60 gpm)					
Drip Frequency in Drops per Second	Fraction Subject to Evaporation and Capture				
	0.10	0.25	0.50	0.75	0.90
	Estimated Amount of TCE Release in Milliliters				
0.5	14.0	11.7	7.80	3.90	1.56
1	28.1	23.4	15.6	7.80	3.12
2	56.2	46.8	31.2	15.6	6.24
3	84.2	70.2	46.8	23.4	9.36
4	112	93.6	62.4	31.2	12.5

Duration of Delivery = 20.7 minutes (Q = 30 gpm)					
Drip Frequency in Drops per Second	Fraction Subject to Evaporation and Capture				
	0.10	0.25	0.50	0.75	0.90
	Estimated Amount of TCE Release in Milliliters				
0.5	27.8	23.3	15.5	7.76	3.11
1	55.9	46.6	31.1	15.5	6.21
2	111	93.2	62.1	31.1	12.4
3	167	140	93.2	46.6	18.6
4	224	186	124	62.1	24.8

Volume Delivered= 621.4 gallons
Estimated Volume per Drop= 0.05 mL

1.3 Summary of Calculation

The above analysis of the January 29, 1980 incident indicates that TCE released to the subsurface associated with this incident could have ranged from zero at the low end if the asphalt pavement was intact and effectively impermeable due to a high asphalt binder content to at most 112 to 224 milliliters (0.165 to 0.329 kg). This likely range of TCE released to the subsurface (0.165 to 0.329 kg) is consistent with the RI observations of an absence of significant contamination in the parking lot area of the Gas Springs Corporation (now Stabilus) facility.

2 Calculation of the Amount of TCE in the OU2 Plume

In the previous section of this memorandum, we have estimated the likely amount of TCE released to the subsurface in connection with the January 29, 1980 observed dripping of TCE during a delivery to the Gas Springs Corporation site by BBI. In this section of this memorandum, we estimate the amount of TCE contained in the subsurface within the OU2 plume as mapped by TetraTech based upon concentrations measured between April 1998 and December 2001 (Tetra Tech, 2002). That mapping of the plume was presented in Figure 4-24 of the Remedial Investigation Report and is reproduced herein as Figure 1.

The OU2 plume flows largely through the fractured rock of the Newark Super Group, specifically the Lockatong and Brunswick formations. Both of these formations are classic “dual porosity” hydrogeologic regimes, in that they have both fracture porosity and significant matrix porosity. Groundwater flow occurs predominantly within the fracture porosity even though quantitatively the matrix porosity is considerably larger. Although the matrix porewater is largely immobile, it represents a large “pool” of groundwater into which contaminants can diffuse from the mobile groundwater in the rock fractures and also from the matrix back into the fractures as concentration gradients change during, for example, remediation efforts.

The extent of this matrix diffusion and its hydrogeologic significance is a function of a number of factors, the most important being:

- The rock’s matrix porosity
- The rock’s fracture porosity
- The matrix diffusivity of the rock
- Fracture spacing
- Time

Time is an important factor. Studies have shown that if a plume has been traveling through a fractured sedimentary rock, with typical dual porosity, for a long period of time (i.e. a few decades) most of the contaminant mass will reside in the matrix of the rock as both a dissolved-phase and a sorbed phase (Wilson and Mutch, 1990; Mutch, et. al. 1993; Lipson, et al, 2005). The sorbed-phase is particularly important in the case of plumes of hydrophobic organic compounds, such as TCE and other chlorinated organics (Lipson, et al, 2005).

Consequently, any attempt to calculate the total mass of TCE in a plume within a dual-porosity hydrogeologic regime, such as the Lockatong and Brunswick formations, must consider the mass that has diffused into the matrix of the rock, which in most cases represents the largest component of dissolved phase mass. This is especially true if the plume has existed for long periods of time as is the case with the OU2 plume. Similarly, in the case of a hydrophobic contaminant, such as TCE, the analysis must consider the amount of TCE mass sorbed to the aquifer skeleton in the rock matrix. The amount of sorbed TCE mass held within the matrix of the rock can be estimated by the method of Lipson, et al, 2005.

The third component of mass within the OU2 plume is TCE in the form of a DNAPL residual saturation. It is not possible to quantify this component of the TCE mass in the subsurface.

In summary, then, TCE mass within the OU2 plume occurs as dissolved-phase constituents within the fracture water and within the matrix pore water of the rock, as sorbed mass within the rock matrix (and to a lesser extent within the fractures themselves) and as localized zones of DNAPL residual saturation. The latter component cannot be quantified.

2.1 Calculation of Total Dissolved Phase Mass within the OU2 Plume

We begin the analysis by calculating the volume of groundwater (both fracture groundwater and matrix groundwater within the plume). We then will use a simple diffusion model to estimate the average concentration of TCE within the matrix pore water of the rock. Lastly, by the method of Lipson, et al, 2005, we will estimate the amount of sorbed TCE mass within the rock matrix. Before delving into that calculation, it is useful to discuss the rock parameters that come into play in such a calculation. The key parameters are the rock's matrix porosity, fracture porosity, matrix diffusivity, the fractional organic content within the rock matrix, and the fracture spacing. While these parameters were not measured in the North Penn RI, they can be reasonably well estimated from studies of similar fractured sedimentary rock.

2.1.1 Matrix Porosity

Virtually all consolidated rock possesses some matrix porosity. Sedimentary rocks, such as the Lockatong and Brunswick formations, tend to have a fairly high porosity. Igneous and metamorphic rocks, in contrast, have quite low matrix porosities. Barrell (1914) reported that the average porosity of sandstone, shale, and limestone are 14.8, 8.2, and 5.3 percent, respectively. In Lipson, et al (2005), they studied matrix diffusion-derived plume attenuation in fractured bedrock. The case study they described was of a rock from the Newark Super Group from the Hartford Basin, termed the New Haven Arkose. This rock had a matrix porosity ranging from 4.4 to 12.9 percent. In their modeling evaluation, they used a matrix porosity of 7.7 percent, which is quite close to the average matrix porosity reported by Barrell (1914) for shale. In our analysis we will use an average matrix porosity of 8 percent.

2.1.2 Fracture Porosity

A review of the literature indicates that the fracture porosity in sedimentary rocks typically lies in the range of 1×10^{-3} to 5×10^{-3} (Streltsova, 1976a, 1976b; Walter and Thompson, 1982; Yurocho, 1982;

Smith and Vaughn, 1985; Kelley et al, 1987). In our subsequent calculations we will use a mean fracture porosity of 2.5×10^{-3} .

2.1.3 Matrix Diffusivity

The matrix diffusivity can be estimated as follows:

$$D_m = \tau D \quad (1)$$

Where:

D_m is the matrix diffusivity [L^2/T]

τ = the matrix tortuosity, dimensionless

D is the free-solution TCE diffusion coefficient [L^2/T]

Pankow and Cherry, 1996, estimated the free-solution TCE diffusion coefficient as $1 \times 10^{-9} \text{ m}^2/\text{s}$. Lipson et al (2005) estimated a matrix tortuosity of 0.2 for sandstone exhibiting a moderate to high matrix porosity. The resultant matrix diffusivity would be $2 \times 10^{-10} \text{ m}^2/\text{s}$.

2.1.4 Fracture Spacing

The high hydraulic conductivity and typical fracture spacing in the Lockatong and Brunswick formation suggests that representative average fracture spacing would be roughly one foot, although localized fracture spacing could be much higher.

2.1.5 Fractional Organic Content of the Rock Matrix

Lipson, et al (2005), measured the fractional organic carbon content of the rock matrix in the New Haven Arkose as 0.0037. We will adopt this value in our analysis.

2.1.6 Bulk Solids Density of the Rock Matrix

Lipson, et al, employed a bulk solid density of the rock matrix of 2.49. This value is reasonable given the nature of the rock and its measured matrix porosity. Consequently, we will adopt this value in our subsequent analysis.

2.2 Modeling of Matrix Pore Water Concentrations

The plume depicted in Figure 1 is based upon samples collected from observation wells screened within the fractured rock. When this type of dual-porosity fractured rock is sampled, the resulting water quality values are generally representative of the mobile fracture flow water. This is because in most cases, the matrix permeability is sufficiently low that little if any matrix pore water is collected by the monitoring wells. However, as mentioned before, the mobile fracture water is but a small fraction of the total water within the plume. Most of the groundwater within the plume is found within the matrix of the rock. It is therefore important to estimate the concentration of TCE present within this matrix pore water,

which constitutes most of the groundwater within the plume. Diffusion of TCE into the matrix pore water is governed by Fick's Second Law given below:

$$\frac{\partial C}{\partial t} = D_m \frac{\partial^2 C}{\partial x^2} \quad (2)$$

Where:

C = the dissolved phase concentration [M/L^3],

x = the distance into the rock matrix from the fracture [L]

t = the time over which diffusion is occurring [T]

In the case of a constituent impacted by sorption, such as TCE, the above equation can be modified to account for retardation of TCE during diffusive transport. The modified form of Fick's Second Law is as follows:

$$\frac{\partial C}{\partial t} = \frac{D_m}{R} \frac{\partial^2 C}{\partial x^2} \quad (3)$$

Where;

R = retardation factor, dimensionless.

Upon comparison of Equation 2 and 3, it is clear that the retardation coefficient slows down the rate of diffusion through the matrix. The partial differential shown in Equation 3 can be solved for $C(x,t)$ assuming a constant concentration source, C_0 at $x = 0$. The following is the well-known solution for concentration at any distance or time (Crank, 1979):

$$C(x,t) = C_0 \left[\operatorname{erfc} \left(\frac{x}{2\sqrt{D_m t / R}} \right) \right] \text{ for } x \geq 0 \quad (4)$$

“erfc” is the complimentary error function which returns values ranging from 0 to 2. Equation 4 can be rearranged to solve for the relative dissolved concentration, (C/C_0) :

$$\frac{C}{C_0} = \left[\operatorname{erfc} \left(\frac{x}{2\sqrt{D_m t / R}} \right) \right] \text{ for } x \geq 0 \quad (5)$$

The retardation coefficient, R , can be calculated with the following equation (Fetter, 2001):

$$R = 1 + \frac{\rho_b}{n} K_D \quad (6)$$

Where:

ρ_b = the bulk solid density of the rock matrix [M/L^3]

n = the matrix porosity (dimensionless)

K_D = the soil-rock partition coefficient [L^3/M].

Assuming linear equilibrium partitioning, the K_D describes the relationship between solid and dissolved phase chemical concentrations (Fetter, 2001):

$$K_D = \frac{C_s}{C} \quad (7)$$

Where:

C_s = the sorbed chemical concentration [M/M].

For organic chemicals such as TCE, it is common to estimate the value of K_D based upon the fractional organic content of the rock, f_{oc} , and the organic-carbon partition coefficient of the constituent of concern, K_{oc} , in this case TCE, using the following equation (Fetter, 2001):

$$K_D = f_{oc} K_{oc} \quad (8)$$

The K_{oc} value for TCE is 152 ml/g (Fetter, 2001). Employing this value of K_{oc} and the earlier-referenced fractional organic content of the rock matrix, we can calculate the soil-rock partition coefficient as follows:

$$K_D = 0.0037 \times 152 \text{ ml/g} = 0.55 \text{ ml/g} \quad (9)$$

We can then calculate the retardation factor, R , for TCE in the rock matrix according to Equation 10.

$$R = 1 + \frac{2.49}{0.08} 0.55 = 18.1 \quad (10)$$

Having now calculated the retardation factor, we can use the equation of Crank (1979) to calculate the diffusion of TCE into the rock matrix at different times. The results of those calculations are shown in Figure 2. The relative concentrations of TCE in the rock matrix compared to the concentration in the mobile fracture water (C/C_0) are shown for 10, 25, and 50 years of the presence of TCE in the mobile fracture water. Given the years of operation of the BAE facility, it is reasonable to assume that this plume had existed more or less in the form determined from the TetraTech remedial investigation for approximately 25 years.

Numerical integration of the modeled profile of TCE within the rock at $t = 25$ years allows for the determination of the average relative concentration. Using the trapezoidal rule ($\Delta x = 0.01$ ft), the average relative concentration of TCE in the rock pore water over the 0.5 ft distance is approximately equal to a value of 0.608. This is shown as the dashed horizontal line of Figure 2. Simply stated, this means that the average concentration of TCE in the matrix pore water is approximately 60.8% of the concentration existing in the adjacent fractures.

It is worth noting at this point that diffusion from rock fracture would be occurring from all the water-bearing fractures within the rock. Consequently, for a typical cube of rock, matrix diffusion would

be occurring from all six faces of the rock. Our analysis is conservative in that we have not taken into account the overlapping diffusive profiles from all sides of the cube of rock.

The total concentration of dissolved-phase mass within the OU2 plume was calculated by first determining the area between OU2 plume contours shown in Figure 1. These areas were then multiplied by an average plume vertical depth of 100 feet to get the volume of plume between or within each of the contour intervals. This depth is based upon geologic cross sections showing the shallow bedrock aquifer system (Tetra Tech, 2003). The volume of groundwater within that volume was then determined by multiplying by the estimated matrix porosity of 0.08. In the interest of being conservative, the volume of water in the fracture porosity was not considered. The contaminant mass within each contour interval was then calculated by multiplying by either the average or the geometric mean concentration within each contour interval (depending upon the contour interval) and multiplying by the relative C/C_0 concentration in the matrix relative to the fractures of 0.608. This calculation is illustrated in Table 2. The total mass of dissolved phase TCE within the plume was determined to be 83.2 kg.

Table 2
Calculation of Dissolved-Phase Mass within the OU2 Plume³

Contour Interval	Area (ft ²)	Volume (ft ³)	Pore Volume (ft ³)	Average Conc. (µg/l)	Calculated Fraction of Mass in Rock Matrix Compared to Fractures	Average Conc. in Rock matrix (µg/L)	TCE Mass (kg)
Inside 1000 µg/L Contour	153,000	1.53×10 ⁷	1.22×10 ⁶	2,560	0.608	1,557	53.9
Between the 1000 and 100 µg/L Contour	621,000	6.21×10 ⁷	4.97×10 ⁶	316	0.608	193	27.0
Between the 100 and 5 µg/L Contour	680,000	6.80×10 ⁷	5.44×10 ⁶	22.4	0.608	13.6	2.09
Between the 5 and 0 µg/L Contour	444,000	4.44×10 ⁷	3.55×10 ⁶	2.50	0.608	1.52	0.153
Total							83.2 kg

2.3 Calculation of Sorbed-Phase Mass within the OU2 Plume

The amount of sorbed-phase TCE mass within the OU2 plume is directly related to the mass of contamination in the dissolved phase as defined by the K_D for TCE in the rock. Under the linear partitioning assumption, the ratio of sorbed-phase TCE concentration to dissolved-phase TCE

³ The fraction of TCE dissolved-phase mass in the rock matrix compared to concentrations in the mobile fracture water (0.608) was calculated by the modeling exercise described in 2.2

concentration is constant throughout the rock matrix irrespective of absolute concentrations, thereby allowing for the calculation of sorbed phase concentrations throughout the rock matrix:

$$C_s = K_D C \quad (11)$$

Since the sorbed concentration is expressed on a mass basis (i.e. mg/kg), the rock bulk density and porosity are required to calculate the sorbed mass, M_s , from the dissolved mass:

$$M_s = M_{dis} \frac{\rho_b}{n} K_D \quad (12)$$

$$83.2 \text{ kg} \times 17.1 = 1,423 \text{ kg}$$

Using this method, we calculate a sorbed-phase mass of 1,423 kg.

2.4 Total TCE Mass within the OU2 Plume

The total mass of TCE within the OU2 plume is given in Table 3.

Table 3
Summary of Estimated TCE in OU2 Plume

Component of Total TCE Mass	Estimated Mass (kg)
Dissolved-Phase TCE	83.2
Sorbed-Phase TCE	1,423
TCE in DNAPL Residual Saturation	Not estimable
Total Mass (without DNAPL Residual Saturation)	1,506

As indicated in Table 3, this calculation does not take into account the amount of TCE mass in the form of DNAPL residual saturation in source areas. It is typically the case at sites where pure-phase solvents have been released to the subsurface that even after long periods of time most of the TCE mass remains in the form of a residual saturation in the soil or rock. Consequently, the actual total mass of TCE within the OU2 plume is very likely substantially greater than that estimated in the above calculation that only considers dissolved-phase and sorbed-phase mass.

3 Fraction of TCE in the OU2 Plume Attributable to the January 29, 1980 Incident

Having calculated the likely range of mass of TCE released to the subsurface as a result of the January 29, 1980 and the total mass of TCE in the OU2 plume (absent DNAPL in source areas), we can readily calculate the fraction of TCE mass attributable to TCE potentially released in the January 29, 1980 incident at the Gas Springs Corporation (Stabilus Site). For this purpose, we will use the lower bound (0.165 kg) and upper bound (0.329 kg) estimates of TCE released to the subsurface in connection with the January 29, 1980 incident. We will also omit any consideration of the portion of the TCE mass in the OU2 plume in the form of DNAPL residual saturation in source areas. The source area(s) have not been sufficiently characterized at this point to permit any estimate of TCE mass in this form.

The fraction of TCE in the OU2 plume attributable to the January 29, 1980 incident can then be calculated as:

$$\text{Fraction} = \frac{\text{Mass of TCE Released in January 29, 1980 Incident}}{\text{Total Mass of TCE in OU2 Plume}} \quad (12)$$

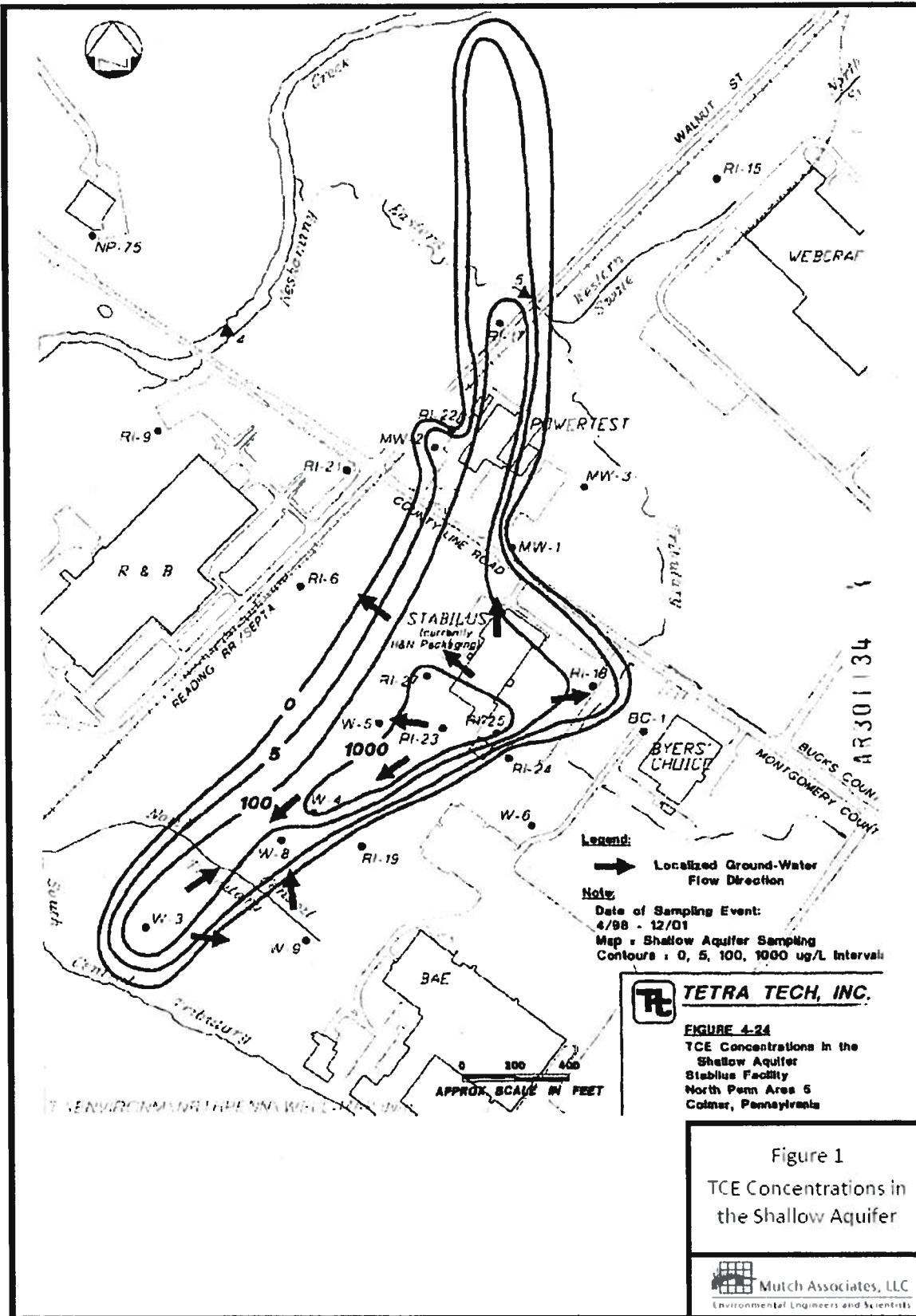
Substituting the values calculated earlier, we calculate the following fraction for the upper and lower bound estimates:

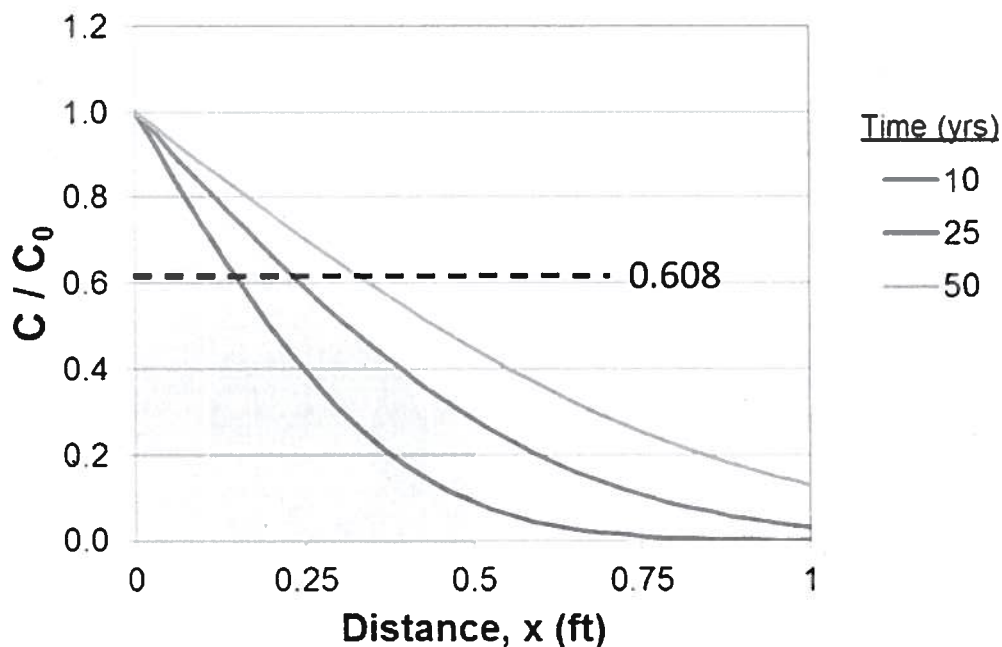
$$\begin{aligned} \text{Fraction (lower-bound)} &= \frac{0.165 \text{ kg}}{1,506 \text{ kg}} = 0.000110 \text{ (0.0110\%)} \\ \text{Fraction (upper-bound)} &= \frac{0.329 \text{ kg}}{1,506 \text{ kg}} = 0.000218 \text{ (0.0218\%)} \end{aligned} \quad (12)$$

While any computation of this type has inherent uncertainties, the fact that the calculation omits any consideration of what is typically the dominant component of solvent mass in the subsurface at sites of this nature, the mass in the form of DNAPL residual saturation, leads to a conclusion that the actual fraction of TCE in the OU2 plume attributable to the January 29, 1980 incident is considerably lower than the range of percentages calculated above.

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Where:

C/C_0 = Relative concentration in rock matrix compared to fracture concentration
 x = Distance from rock fracture into rock matrix in feet

Parameters:

Matrix porosity = 0.08
 Matrix Diffusivity = 2×10^{-10} m²/s
 Bulk solids density of rock matrix = 2.49 g/ml
 Fracture spacing = 1 foot
 Fractional organic content of rock matrix = 0.0037
 K_{oc} of TCE = 152 ml/g

Figure 2
 Calculated C/C_0 Concentration
 of TCE in Rock Matrix at Times
 of 10, 25, and 50 years



Mutch Associates, LLC
 Environmental Engineers and Scientists

Appendix G

Memorandum

Settlement Confidential

Date: July 25, 2012
To: Chris French, Remediation Manager, Honeywell
CC: Robert D. Mutch, Jr., Mutch Associates
From: Gary DiPippo, Cornerstone Environmental Group
Subject: North Penn Area 5 Superfund Site, Cost Estimate
Project No.: 120394

In connection with settlement discussions with the United States Environmental Protection Agency ("EPA") regarding alleged liability for the remediation of Operable Unit 2 ("OU2") at the North Penn Area 5 Superfund Site (the "Site"), Honeywell International Inc. ("Honeywell") engaged Cornerstone to review the available remedial records for the Site and estimate potential future remediation costs for the Site. This memorandum provides, and summarizes the basis for the cost estimate that Cornerstone prepared.

A remedy has not yet been selected for the Site and, therefore, estimating remedial costs using a specific remedy is not practicable. However, it is possible to project a likely range of costs based on remediation at sites that would likely have similar remedy components. The Site remediation involves chlorinated solvent contamination in groundwater. Therefore, a comparative approach for the Site should focus on remedial sites that also involve chlorinated solvent contamination in groundwater.

In May 2010, the Government Accountability Office ("GAO") issued a report entitled *EPA's Estimated Costs to Remediate Existing Sites Exceed Current Funding Levels, and More Sites Are Expected to Be Added to the National Priorities List* ("GAO Report"). The GAO Report contains useful, current information regarding the Superfund program that permits a representative analysis of costs at sites where remediation expenditures would be expected to be similar to the Site. Appendix III of the GAO Report provides summary descriptions of 75 sites on the National Priorities List ("NPL") as of 2009 that EPA identified as having "unacceptable human exposure." Appendix IV provides similar summary descriptions of NPL sites that the EPA identified to receive Recovery Act funding.

Appendices III and IV provide a basis to select representative sites for a cost analysis where "unacceptable human exposure" or the need for funding has been identified by the EPA. For several reasons, the use of these sites would not be expected to underestimate potential costs for the Site. First, EPA defines "unacceptable human exposure" as "actual or reasonably expected exposures of an individual to hazard substances, pollutants, or contaminants at levels that present unacceptable risk...." The GAO Report provides, consistent with this characterization, that "...average annual per-site expenditures for sites with unacceptable exposure have been considerably higher than for sites with unknown exposure or for sites where EPA has determined

that human exposure is under control.” Second, consistent with the goal of Recovery Act funding, the GAO Report indicates that these funds were “...targeted first toward sites with ongoing construction and then toward new projects that were construction-ready.” These sites, therefore, are not no-action or limited action sites, but rather sites with remedial construction underway or ready for implementation. Finally, application of the Pennsylvania Act 2 criteria to the Site’s remediation as an ARAR would likely reduce the remediation costs in comparison to the estimates presented in this memorandum. Therefore, by relying exclusively on the sites in Appendices III and IV, this memorandum presents an estimate of the Site’s potential remediation costs that is unlikely to underestimate costs.

Cornerstone reviewed the GAO Report and selected sites for which the principal contaminant issue is chlorinated solvents in groundwater (e.g., as opposed to, for example, PCBs in soils). The following sites were identified from these lists for this purpose:

- Southeast Rockford Groundwater Contamination, Illinois
- Caldwell Trucking Company, New Jersey
- Bally Groundwater Contamination, Pennsylvania
- Jones Road Groundwater Contamination, Texas
- Continental Steel Corporation, Indiana
- Lawrence Aviation Industries, New York
- Old Roosevelt Field Contaminated Groundwater Area, New York

Each of these sites involves groundwater contamination, often in a publically used aquifer and in one case a sole source aquifer (Old Roosevelt Field), and principally from chlorinated solvents. These sites also have used a range of remediation approaches including groundwater extraction and treatment, source removal, source treatment, connection to municipal or alternative water supply, and in situ treatment. See Table 1 below.

For each of these sites, available cost estimate information was taken from EPA’s CERCLIS database. In collecting cost data for each of these sites, cost elements that clearly are not typical of the nature and extent of contamination at the Site were excluded in an effort to normalize the data. For example, the Continental Steel Corporation site has operable units associated with a quarry, streams, slag processing, and building remediation that would not correlate to the Site. In using cost information from the Continental Steel site, these inapplicable operable units were not used.

Table 1 below summarizes the information associated with each of the comparative sites used in this cost analysis. This table includes the site name, a brief description of the remedy components, and the estimated net present worth of capital and operations and maintenance costs. Costs are rounded to the nearest million dollars for ease of presentation. For some sites (e.g., Jones Road), removal actions were performed for which the CERCLIS database does not have costs. Given the provisions in CERCLA (Section 104(c)(1)) and the NCP (40 CFR 300.415(b)(5)) limiting fund-financed removal actions to 12 months and \$2,000,000 dollars, for the purpose of this comparative analysis, \$2,000,000 was added for each relevant removal action noted in the CERCLIS records.

Table 1: Comparative Sites Used for Cost Analysis

Site	Remedy Components	Estimated Net Present Worth Cost
Southeast Rockford Groundwater Contamination, Illinois	Water line extension, municipal well treatment, source area treatment (excavation and low temperature thermal desorption, soil vapor extraction, air sparging)	\$28,000,000
Caldwell Trucking Company, New Jersey	Alternative water supply, municipal well treatment, excavation and treatment/disposal of source material, groundwater extraction and treatment	\$22,000,000
Bally Groundwater Contamination, Pennsylvania	Water line extension, new municipal supply well, groundwater extraction and treatment	\$8,000,000
Jones Road Groundwater Contamination, Texas	Water line extension, groundwater extraction and treatment with in-situ bioaugmentation	\$12,000,000
Continental Steel Corporation, Indiana	Groundwater extraction and treatment with discharge to a POTW; wastewater lagoon solids removal, consolidation, and RCRA closure	\$51,000,000
Lawrence Aviation Industries, New York	Connections to public water supply, surface soil removal, groundwater extraction and treatment, and in-situ chemical oxidation	\$26,000,000
Old Roosevelt Field Contaminated Groundwater Area, New York	Groundwater extraction and treatment	\$13,000,000

The mean cost for these sites is \$23M. The costs shown in Table 1 appear in the Records of Decision and Feasibility Studies for these sites. Per the *USEPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA/540/G-89/004), these cost estimates are expected to have an accuracy of -30/+50%. When applied to the arithmetic mean of cost estimates in Table 1, the likely range of costs for remediation of a site with remedy components similar to the North Penn Area 5 Superfund Site falls within the range of \$16,000,000 to \$35,000,000.

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We hope that this analysis is useful. Please let us know if you have questions or require additional information.